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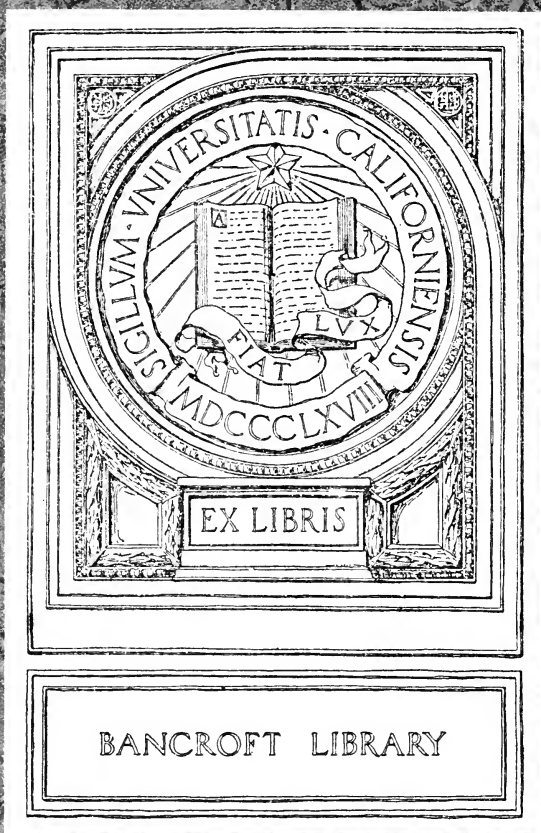
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Report of F.M. Case, Surveys

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UNION PACIFIC RAILROAD.

REPORT OF F. M. CASE,

OF

Surveys of Cache La Poudre & South Platte Routes,

AND

OTHER MOUNTAIN PASSES IN COLORADO.

OMAHA, Neb. T'y, Dec. 15, 1864.

SIR,—Under my instructions to gather, by actual survey and otherwise, whatever information I could relating to the mountain passes of Colorado, I have the honor to submit the following:

REPORT.

These passes, or such of them as have been spoken of as possible or practicable for railroad purposes, are, the Caché La Poudre, the Boulder, the Berthoud, a pass at the head of the North Fork of the South Platte, one at the head of Tarryall creek, and the Hoosier Pass near Montgomery.

THE BOULDER PASS.

From information obtained from Mr. D. C. Collier, a very intelligent explorer of Colorado, and now editor of the *Miners' Register*, of Central City, and from other sources, I judge the Pass to be at least \$11,900 feet above the level of the sea. The

valley (of S. Boulder,) at the foot of the mountains cannot be more than 5,600 feet. The elevation of Boulder City, six miles north, on North Boulder, being 5,536 feet. This leaves a difference of elevation of 6,300 feet, and this elevation must be overcome in a distance at most of 35 miles. Knowing these facts, I have not even visited the Boulder Pass.

THE ROUTE UP THE NORTH FORK OF THE SOUTH PLATTE,

Would enter the mountains at the cañon of the South Platte, follow up that stream about 10 miles to the mouth of the North Fork, thence up that stream 35 miles to the range, and thence connect with one of the heads of Snake river, an affluent of the Blue. The pass is represented by Hon. Daniel Witter, another very intelligent explorer of Colorado, as being a little below the "timber line," probably about 11,500 feet above tide-water. From elevations kindly furnished me by Dr. C. C. Parry, I am enabled to give some information that may be of use in judging of this route. At a point 12 or 15 miles below the pass ("The Forks,") the elevation is 9,153 feet, at 7 miles below it is 8,405, and at a point 4 miles further down 8,018, indicating that a practical grade would follow the valley to "The Forks." The trouble I apprehended would be to overcome 2,300 feet elevation in the 12 or 15 miles from that point to the pass, without a very long tunnel.

The descent upon the western slope to the mouth of Snake river, a distance of not more than 20 miles, is 2,700 feet, upon the hypothesis that the pass is 11,500 feet above tide-water. The route for the entire distance from the plains to the Blue is through a narrow valley, and in many places doubtless very tortuous.

THE TARRYALL CREEK ROUTE

Enters the mountains *via* South Platte, and follows up the main stream 10 or 12 miles further than the last mentioned route, where it diverges, following up the valley of Tarryall creek some 25 miles to the South Park, thence near the creek across the Park to Hamilton and Tarryall, thence up the main stream to

a pass about the height of Hoosier Pass, from which it descends Indiana Gulch to the Blue above Breckenridge.

Of this route I can say but little advisedly. Dr. Parry gives the elevation of Tarryall (old town) at 9,932 feet. The pass, at a distance, in my opinion, not exceeding six miles, is 1,500 feet higher. I do not think that the maximum grade allowed by the charter would go within two miles of the pass, following the stream. Whether there is any way of making distance on this approach or not I cannot tell, as I have not had an opportunity of examining the route from Tarryall to the pass. I have been down Indiana Gulch to the Blue, and should say the descent was 150 or 200 feet to the mile.

THE SOUTH PLATTE ROUTE.

I have made a partial survey of this route, and report herewith a profile of Hoosier Pass, a profile of a line 18 miles down the Blue, and one of a line 48 miles down the South Platte, through the South Park to the head of the cañon.

A tunnel of $2\frac{1}{2}$ miles in length would be required at the crossing of the range. This tunnel would be through granite the entire distance, and would doubtless cross several gold lodes, which crop out upon the western, or rather northern slope.

The line upon the western slope would have to follow the side of the mountain to get a practical grade. I should think distance sufficient could be gained upon the east side of the Blue to allow the grade to reach the valley a few miles below Breckenridge, from which point to the mouth of the Blue the line would follow a fine wide valley, with easy grades, as indicated by the profile, and good alignment; except that the valley makes but very little westing in its entire length.

A line down the South Platte may be located so as to secure, very nearly, a uniform grade from the mouth of the tunnel to the head of the cañon, where my line terminates, with light curves and light work, as the profile indicates.

When I reached the head of the cañon, I found, by examination, that it extended 9 or 10 miles, and there being no way of moving camp down the valley, except by "packing," I concluded

to abandon the survey. From the head of the cañon to the plains, a distance of some 40 miles, the river runs all of the way through the mountains. The greater portion of the distance the valley is of sufficient width to admit of a good location for the road, but there would probably be 20 miles, at least, of "close" cañon, or one both walls of which are washed by the stream. There would necessarily be a good deal of tunnelling in the cañon—how much I cannot say. I estimated the height of Hoosier Pass to be 11,500 feet above the sea. This estimate I formed from its being about 200 feet below the limit of arborescence or "tree line," which in that locality is about 11,700 feet above tide-water.* Allowing the pass to be as estimated, the elevation at the head of the cañon will be 8,432 feet. Calling the mouth of the cañon 5,700, it would leave a difference of elevation of 2,732 feet between the mouth of the cañon and its head, making an average grade of less than 70 feet per mile.

In the matter of grades, I do not hesitate in the opinion that there is no route in Colorado with so easy an approach, on both sides of the main range of mountains, as this route. Yet the easy grades are made at the sacrifice of general alignment. There will be a line of about 145 miles in length to make 76 miles of westing between Denver and the mouth of the Blue.

There is an abundance of timber, the mountain varieties of fir, spruce, and pine, along the whole route, except that in the Park it is some distance from the line. Good building stone and limestone may be easily procured from the ridges of stratified rock that intersect the Park, and in the same formation in the valley of the Blue.

From what information I have gleaned, in three and a half years residence in Colorado, the snow falls in the basin of the Blue and in the vicinity of Hoosier Pass deeper than in any part of Colorado. From some person (I cannot now remember who gave me this information,) who kept a meteorological record

* I have since learned from Dr. Parry that the "tree line" at Georgia Pass, the nearest point to the Hoosier Pass, at which it has been taken, is 11,487 feet.

at Georgia Gulch, during the winter of 1861-2, I learned that the total fall of snow at that place was 37 feet; and in one storm in February, 1862, 11 feet. Georgia Gulch is on the western slope—one of the gulches of Swan river, an affluent of the Blue.

THE BERTHOUD PASS ROUTE.

I did not have time to make any further examination of this route the past season, and have but little information to report that is not contained in my report to Gov. Evans in 1862. Which report, with a few corrections, such as further experience in the geology and climatology of Colorado dictates, I here insert, that I may embody in one paper all the information I have been able to obtain upon the subject, up to the present date.

“COLORADO TERRITORY, }
Denver, August 15th, 1862. }

“HON. JOHN EVANS, GOV.

Col. Territory:

“Sir,—In submitting to you this report of my late instrumental reconnoissance of the Berthoud Pass and its eastern approach, with the view of its being by you laid before the Board of Corporators of the Pacific Railroad, I am aware that the facts which will be of real interest to practical railroad men are very meagre; yet, as many misrepresentations have been made upon mere opinion, the few facts I have gleaned may be of interest to the Board of Corporators, of which you are a member.

“I have had a connected line of levels run from the Platte River (at the upper bridge in Denver) to the summit of the Pass and two and three fourths miles down Moses Creek, on the Pacific slope. From one mile below Empire City a transit line has been run over the Pass—levels have been run up Clear Creek, a mile and a half above the mouth of Hoopes Creek, opposite the pass, and also from Empire City to the low pass between Bard Creek and the south fork of Clear Creek. Between this low pass and Georgetown, one and three-fourths mile south, the relative elevations have been ascertained by barometric

observations, by Dr. Parry, a gentleman who is spending the summer near the Range, making scientific explorations.

"I submit herewith a map of the route from Denver, westward, embracing the Pass, giving a very fair representation of the topography of the country in the vicinity of the Pass, with the relative elevations at certain points, as ascertained by the levels. Upon this map I have drawn a proposed location of a railroad line, which, in my opinion, will be near the most practicable route for the real location. The length of the tunnel I make three and a half miles. I have made this length by supposing an up-grade of fifty feet to the mile, running westward in the tunnel from the entrance, for two miles, and thence running a down grade of ten feet to the mile, to the exit.

"An up grade in the tunnel of one hundred feet to the mile for the first two miles, instead of fifty, would shorten the tunnel about one-fourth of a mile. The grade, as you will notice, is less than 116 feet to the mile from the forks below Empire City to the tunnel, but the equation for curvature, on the line I have drawn, would probably bring the grade up to this maximum.

"This range of mountains, on its eastern slope being subject to a very considerably less fall of rain during the year than the Alleghanies or New England mountains, are much less disintegrated, and are fitly called "Rocky Mountains." The mountains on either side of the valley of Clear Creek are "rugged," with frequent points of rocks projecting into the valley; for this reason I have drawn the line so as to get down into the valley with the grade as soon as possible.

"I might say in this connection, that there would be a *possibility* of striking rich gold lodes in the construction of the tunnel, for it is in the "Gold Belt." there being lodes on each side of the pass, yet, I would not like to undertake the construction of the tunnel with the understanding that I should take this "possibility" in "part pay."

"Of the Western approach to the Pass I will hazard no opinion as to gradients or courses. The Western slope of the Range seems to be covered with a much deeper soil, as it is covered with a much denser foliage, which is doubtless owing to the arrest and precipitation of the spring and summer rains by the snow of the Range; the prevailing winds being northwesterly.

This fact, in case of having to keep the mountain sides to get down to the valley of the Grand River, would render the cost of construction much less than upon the Eastern Slope.

"I have made considerable inquiry as to the winter snows in the neighborhood of the Pass, and find that at Empire City, they have wintered cattle every winter without hay. From all the statements of settlers on the experience of three winters, I am of opinion that the winter snows would form no serious obstacle to the running of railroad trains from the tunnel eastward. About three-fourths of a mile from the Pass, on the western slope, we passed a camp where a family were snow-bound last winter, for some weeks, and judging from the height of the stumps of trees cut by them while there, should think the snow must have been five or six feet deep. This depth, from all the information I can glean, would be about a fair average for about fifteen or twenty miles west of the Range, in the vicinity of the Pass. The prevailing winds being from the northwest, the snow piles in immense drifts on the southeastern slopes of the range. These slopes, in the vicinity of the Pass, being very precipitous near the summit, arrest the snows before they reach the valley of Clear Creek. This fact may account for the light fall of snow near Empire City.

"The following table will show very nearly the distances between the points at which I have ascertained the elevations above the Platte at Denver, along the proposed route from Denver, westward to the Pass :

Places.	Distances.	Elevation.
Platte River, at Denver.....	.0 miles.	0.
Divide between Denver and Golden City...	7.5 "	544.
Golden City.....	5.0 "	500.
Ten miles up the Cañon.....	10.0 "	1580.
Where Idaho road enters valley of Clear Creek.....	6.8 "	2019.
Idaho.....	5.2 "	2395.
Forks of Clear Creek below Empire City...	7.3 "	3117.
Georgetown.....	4.0 "	3519.
Entrance of Tunnel.....	13.0 "	4820.
Total distance from Denver.....	57.8 "	—

"In entering the Cañon of Clear Creek, either from Denver or the mouth of Clear Creek, the road can go into the Cañon from one to five hundred feet above the water of the creek, if a better line can be found at such elevation.

"Of the cost of construction of a railroad from Golden City to the entrance of the tunnel, I cannot, of course, make an estimate upon this reconnoissance, but should say the expense would not be greater than the average of eastern mountain roads for the same distance.

"Hoping these few facts may be of service to you and the Board of Corporators of the Pacific Railroad, I am,

"Very truly your obedient servant,

"FRANCIS M. CASE,
Civil Engineer."

Since writing the foregoing report I have obtained from Dr. Parry the elevation of the head of Middle Park, about ten miles from the pass on the western slope, which is 8,949 feet, or 1,340 feet lower than the mouth of the proposed tunnel $7\frac{1}{2}$ miles above. The Hot Springs on the Grand river, 20 miles farther down, he makes 7,546 feet, showing an average grade from the head of the park to the Hot Springs of about 70 feet to the mile.

There is one difficulty that would be encountered upon this route not mentioned in the above report, and that is in the form of avalanches or glaciers, which occur occasionally at two different points near the foot of the pass, upon the mountain side south of Clear creek. The mass of snow and ice which accumulates at the head of gulches at these points, loosening next to the mountain by the action of the water from the melting snows, sweeps down the mountain side with a velocity that carries everything before it. At the one above the mouth of Hoope's creek, I saw trees and rubbish which had been driven before the avalanche across the creek, and four or five hundred feet up the northern slope of the valley. A located line would cross the track of both these avalanches.

THE CACHE LA POUDE ROUTE.

Over this route I have run a preliminary line, commencing at

La Porte, and running as indicated by the red line upon the accompanying map, I connected with Mr. Evans' line at his station 1,360, near the crossing of Laramie river.

Being entirely unacquainted with the topography of the country along this route, I kept my line in the valley of streams until I passed Cherokee station, and thence along what appeared at first sight to be the most feasible route. My party being short I was obliged to be with them so much that I could not devote as much time to reconnoissance as I otherwise would. I very much regret that I had not time to run a new line nearly or quite the whole distance from La Porte to the summit; and also to try a line over the divide to the head waters of Crow creek. I think I can get a fair line with lighter grades from La Porte to the Laramie Plains than are shown by any line yet surveyed over the Black hills. Yet this is only my opinion. An actual survey only will determine this point. Some points are already settled by the present survey. One is, that Antelope Pass is 593 feet lower than the summit made upon the Cheyenne Pass route. Another is, that the descent to the Laramie Plains from Antelope Pass may be made with a grade not much, if any, exceeding 80 feet per mile.

I have indicated, by a red dotted line upon the map, my proposed location. I think a line may be obtained with a practical grade by keeping in a valley to the right of the stage road, and coming into the road, or near it, above Boner station. If so, it would be very much preferable to any line following the Cache La Poudre and Dale creeks. For those valleys being so narrow the grade must, of necessity, be laid at least 25 feet above the bed of the stream. Evidences of the flood of last spring show that the water was 20 feet above its present stage.

If this route should be found to be impracticable, I would try a route as indicated by the westerly dotted line passing over (or rather going through with a thousand feet tunnel) a low pass, about opposite the junction of Dale and Cache La Poudre creeks, and keeping along the eastern slope of the valley of Dale creek join the other line near the crossing of Stonewall creek. From this point, I think, by keeping up the divide west of this creek, the line would enter Stonewall cañon at a height sufficient to get a fair line through the cañon, and reach an elevation at its head

which would admit of getting up the divide beyond and near the stage road with a grade not exceeding 2.2 feet per station.

Much time and care should be bestowed upon a located line, as the country, especially from Poison creek to the pass, is very rough, broken by points, and ledges of granite thrown up promiscuously. In some places you see only bare and isolated peaks, in others, ledges, trending in every conceivable direction.

In this connection allow me to suggest that a thorough examination should be made of the divide, east of Dale creek, and a few miles north of Virginia Dale, at the heads of Crow creek and Box Elder. From what information I can get, the foot of the mountains east of this point is as high, or even higher than the starting point of Mr. Evans' line. That point is 1,953 feet higher than my starting point at La Porte. Now, if by some branch of Crow Creek or Howard's Fork, we can find a uniform grade to the summit, I think such grade will be within the limit fixed by the charter of the road. By reference to the map you will see that such a route would connect with a line up the South Platte, with a much better general alignment than by La Porte; or would connect with the Lodge Pole Route, by way of Muddy Fork, without a serious sacrifice of alignment. [See also Stansbury's Report, p. 258, *et seq.*]

If a route can be obtained up the valley, east of Boner station near the line I have drawn, it would pass over, from La Porte to Stonewall Cañon, soil that is underlaid by stratified rocks, with occasional outcrops of the latter. From Stonewall Cañon to Laramie Plains, the formation is all primitive; most of the way however, the surface is covered with a soil—the result of the disintegration and decomposition of the granitic rocks. In the Stonewall cañon the granite is close grained, hard, and intersected by veins, or dykes of some basaltic rock. Toward the Laramie Plains, the feldspar predominates, rendering the rock more friable, and susceptible to disintegrating agencies.

As far as my observation extended, the primitive formation along the route shows no traces of any mineral veins whatever. My 2d assistant, Mr. Pim, says there is no doubt that Rock creek, furtherwest, comes down from a gold region. That he has seen the evidences himself; and also assured me that there

was a large body of iron ore in the vicinity of our line, (he would not say where,) that he had also seen himself.

I did not see any indications of coal, in the later formations along the route. I did not look for them in the vicinity of the primitive rocks, believing that coal will not be found in such localities. The intense heat, at some period of their geological history, having driven off, or consumed the carbon, if it were ever there.

There is a sparse growth of timber, in places along the route, mostly a dwarfed variety of pine. South of the line, and at no great distance, appears to be a heavy growth of good timber.

I think there would be little difficulty in rafting timber down the Cache La Poudre, and less still in getting it down the Big Laramie.

Accompanying this report I have the honor to submit condensed profiles of the Cache La Poudre, the Berthoud, and the South Platte routes. These profiles are made from my own surveys, and from such other data as I have been able to obtain. The grades in these profiles are broken to show the general undulations of the surface only. I also submit maps of the lines run during the past season, together with a map of Colorado, showing, approximately, all the different routes.

I have made no estimate of quantities upon any of these routes, for the reason that as yet I have not had time to run a line approximating the best location sufficiently near to make an estimate upon.

Respectfully submitted,

FRANCIS M. CASE,

Div. Engr.

To T. C. DURANT, Esq.,

Vice-Pres't U. P. R. R. Co.,

No. 13 William st., New York.

